

Ya. PERELMAN

LABYRINTHS



The Mir Titles Project

Labyrinths

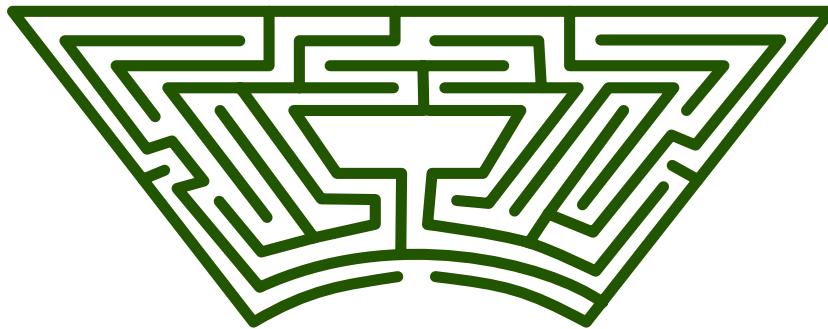
Yakov Perelman

1931/2024

Contents

1	<i>Through The Garden Alleys</i>	2
2	<i>The One Hand Rule</i>	4
3	<i>Ancient Labyrinths</i>	6
4	<i>Labyrinths – Puzzles</i>	9
5	<i>Labyrinths-Caves</i>	14
6	<i>Labyrinths-Puzzles</i>	15
7	<i>Experiments With Animals</i>	18

1 Through The Garden Alleys



Cover *E. Budogosky*
Second Edition
State Publishing House
Moscow, Leningrad, 1931.
Translated to English
by *Damitr Mazanav.*
English version released in 2024 by
The Mir Titles Project
<https://mirtitles.org>
Original scan by *Russian Lutherean*
https://archive.org/details/20200404_20200404_1656/

Figure 1: The hedge labyrinth at the Hampton Court in town of Hampton, England.

Figure 1 shows a plan of garden paths that lies between the high walls of residential and urban areas. White stripes represent paths, while green lines depict hedges. Imagine yourself standing on the central lawn of this garden and wanting to reach the exit. Which way would you choose? Sharpen a match, insert its point into the lawn, and attempt to trace along the garden paths. You'll likely need to wander through many nooks and crannies before finding a way out. And what if you actually found yourself in a garden like this?

It would be incomparably more challenging because you wouldn't see all the garden paths depicted in the drawing.

Such intricate passages are called "labyrinths". The labyrinth garden, depicted in the title picture, is situated in England, in the town of Hampton, and is often visited by the curious. This is how the English writer Jerome describes bluffing in this maze in the comic story *Three Men in a Boat*:

Harris recounted his visit to The Hampton Maze. After studying the maze plan at home, he concluded that its layout was simply stupid and hardly worth paying to visit.

'We'll navigate the entire maze in ten minutes,' Harris confidently told his companion.

In the maze, they encountered a whole group who had been wandering for about an hour and were eager to find a way out. Harris offered to lead them, claiming he had just entered and would only make one lap. Everyone was delighted and followed Harris.

On their way, new travellers joined them until the entire crowd, wandering through the maze, assembled. Those who had lost hope of finding their way out and seeing their families and friends again were encouraged by the sight of Harris and joined the procession, blessing him. In total, there were about twenty people, including a woman with a child, who had spent the whole morning in the maze and now clung to Harris's hand to avoid accidentally losing him. Harris continued to turn right, but the path proved to be very long, and Harris's acquaintance observed that the maze seemed exceptionally large.

'Oh, one of the largest in Europe!' confirmed Harris.

'It must be,' said someone among the travelers, 'we've already walked a good two miles.'

Harris remained in good spirits until he stumbled upon a piece of gingerbread lying on the ground. Harris's companion swore he had seen that very piece seven minutes ago.

'It can't be!' said Harris.

However, the woman with the child insisted that, on the contrary, it very well could be, as she herself had dropped that gingerbread before meeting Harris. It would have been better for her not to have met Harris at all; it's clear that he's a cheat. Harris was outraged. He pulled out the map and began to prove that they were on the right path.

'A map would be useful,' remarked one of the companions, 'if only

we knew where we were.'

Harris didn't know either. He suggested going back to the exit and starting over. Everyone trudged back. Ten minutes later, the company found itself back in the centre of the maze.

Harris wanted to claim that he had intended to come here, but he sensed the dangerous mood of the crowd and pretended that he had arrived by accident.

Regardless, they had to go somewhere. Now knowing where they were, they consulted the map again. It seemed there was no way out, so they set off for the third time.

Three minutes later, they found themselves back in the centre of the maze...

They attempted to escape the maze many times, but to no avail. Wherever they went, they always ended up back in the centre. This happened so frequently that some decided to stay put and wait until their companions circled back to them. Harris pulled out the map, but its mere sight infuriated the crowd.

Ultimately, they became completely disoriented and began calling for the watchman. He appeared, climbed the external stairs, and shouted directions to them.

However, everyone was so lost by then that they couldn't comprehend anything. So, he shouted for them to stay put and wait for him. They huddled together and waited, while he descended the stairs and approached them.

The watchman was young and inexperienced; upon entering the maze, he couldn't locate the stranded people and futilely attempted to reach them. Eventually, he became lost himself. Occasionally, they spotted him darting around on the other side of the fence, and whenever he saw them, he rushed toward them, only to reappear in the same place a minute later, asking where they had gone.

They all had to wait until an old watchman arrived to rescue them.

2 The One Hand Rule

There is a very simple way to enter any maze without fear of getting lost in it. Using this rule, you can always find a way out of any maze, no matter how confusing its pathways may be. Here are the rules of safe wandering in mazes:

It is necessary to walk through the maze, all the time touching its wall with the same hand.

This means that when entering the maze, you must touch its wall with one hand (whether right or left) and during the whole time of wandering in it, you must press to touch the wall with the same hand.

Try – to test this method – to apply the “one-hand rule” for a mental walk through the plan of the Hampton Maze. Armed with a match, imagine that you enter this garden maze and touch its walls with one hand all the time. You will soon get from the outer entrance to the centre of the maze. Don’t lower your hand here, keep going then, touching the walls with it, you will unerringly get out of its nooks and crannies again to the outer entrance.

Where did this convenient rule come from? Let’s try to understand this. Imagine, that you enter blindfolded into a room with only one entrance (Figure 2).

What should you do to go around it all and get out of it again? The easiest way is to walk along the walls without taking your hands off the wall (Figure 3), then you will certainly find yourself back to the door through which you entered. Here, the reasonableness of the “one-hand rule” is self-explanatory.

Now imagine that the walls of the room have projections, as shown in Figure 4 and 5. In front of you are no longer simple rooms, but real labyrinths. But the “one-hand rule” should, of course, remain in force in these cases, reliably leading you back to the exit from the room.

The “one-hand rule” has its disadvantages. Using it, you can enter any maze and surely exit it. But this does not mean that you will go through all the corners of the maze without exception. You will only visit in those places, the walls of which are connected with the outer wall of the maze, constitute, as it were, its continuation.

But you will pass by those sections of the maze whose walls have no connection with its outer walls. There is just one in the garden maze of the Hampton Court such a section, and therefore, using the “one-handed” rule, you cannot walk along all the paths of this maze: one track remains untraveller.

In Figure 6, the dotted lines show the path along the walls of the hedge, if you use the “one-hand rule”, and the hedges coloured red mark the alleys that remains uncrossed.

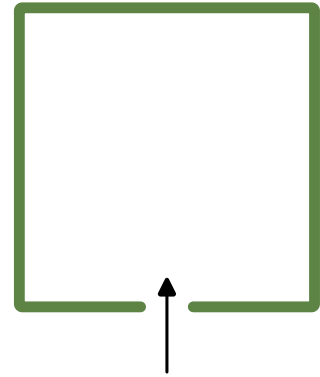


Figure 2: Understanding the one-hand rule using a room with a single entrance.

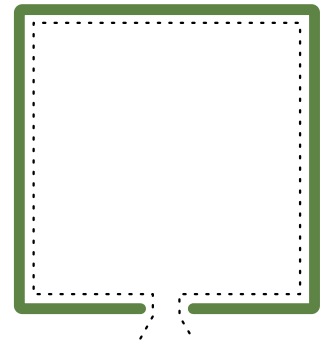


Figure 3: Walking along the wall without taking your hands off the wall will take you out of the room.

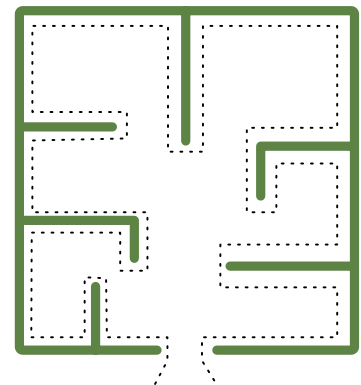


Figure 4: The one-hand rule in a room with projections.

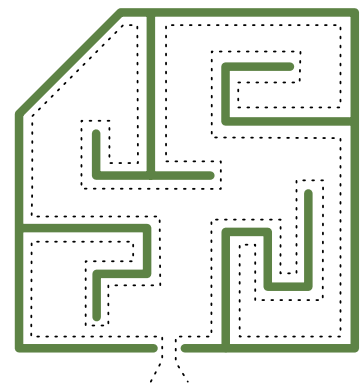


Figure 5: The one-hand rule in a room with more projections.

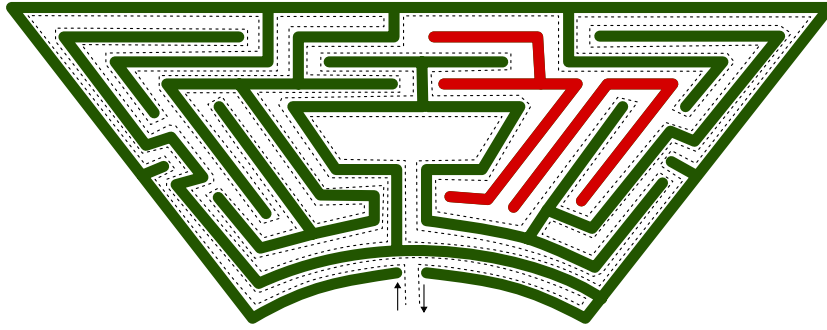


Figure 6: The one-hand rule applied to the Hampton Court labyrinth showing how to traverse it. The alleys which are uncrossed while traversing the labyrinth are marked in red.

3 Ancient Labyrinths

Nowadays, mazes are arranged for entertainment. A section of the park is set aside for a maze; visitors walk along its winding paths between the high walls of the hedge.

But in the olden days, the labyrinths were not arranged for entertainment at all. They were not built in the open air, but inside buildings or even underground. There was a time when labyrinths served as a means of execution: people trapped in them hopelessly wandered through a long network of corridors, passages, halls, until they died of exhaustion and starvation. The most ancient labyrinth, according to legend, was located on the island of Crete, in the Mediterranean Sea: its crossings were so confusing that, according to legend, the builder himself couldn't find a way out of them. Is there really such a labyrinth?

A specially built maze on the island Crete is unknown. It is possible that the reason for the appearance of this legend was the natural labyrinths in the underground caves of Crete or the intricate passages in its quarries.

But in ancient times, there were undoubtedly labyrinths built hastily, which were intended to protect the graves. The tombs of rich rulers were surrounded by a network of intricate passages so that thieves would not get into them. The tomb was located in the centre of the maze, and even if the robber managed to get to the hidden treasures, he could not find a way out. The rule of "one-hand" could not help robbers; in ancient times, this rule was not yet known, and besides, it does not always make it possible to get around everything the passages of the maze. It is easy to arrange such a maze, wandering through which according to the rule of "one-hand", you just miss the place where the treasures are hidden.

On our distant north, in the Arkhangelsk province, along the

shores and islands of the White Sea, as well as in Lapland, there are remnants of anciently built labyrinths. These labyrinths were constructed quite crudely - simply laid out of large boulders. By whom they were built and for what purpose is unknown. Local residents call them “vavilons”, but they cannot say anything about their origin and purpose. And it’s not surprising: these “vavilons” were built no less than three thousand years ago, and in the folk memory, there are no traditions preserved about who and why built them.

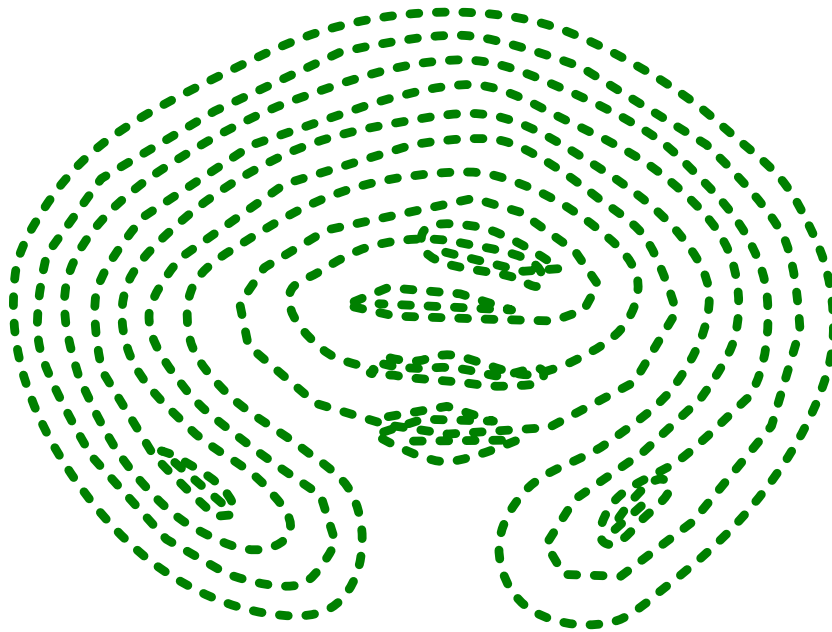


Figure 7: The plan of the labyrinth on Solovetsky Island (in the White Sea).

Figure 7 shows a plan of the labyrinth on Solovetsky Island (in the White Sea). It has the shape of a horseshoe; length its internal passages are about two hundred meters.

Figure 8 shows a different kind of maze – a round one; it is located near the village of Rest, Arkhangelsk province. Compare its appearance with the ancient garden maze of England (Figure 9): the similarity is striking. The English maze is much newer than the Arkhangelsk one, but the British builders, of course, did not visit the village of Rest. Obviously, all such structures were built according to the same ancient model throughout Europe.

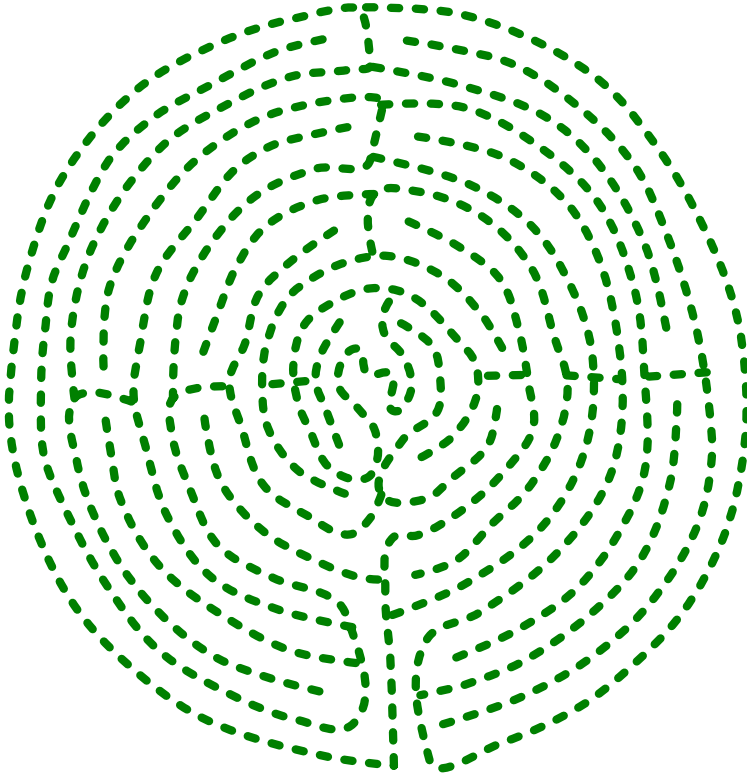


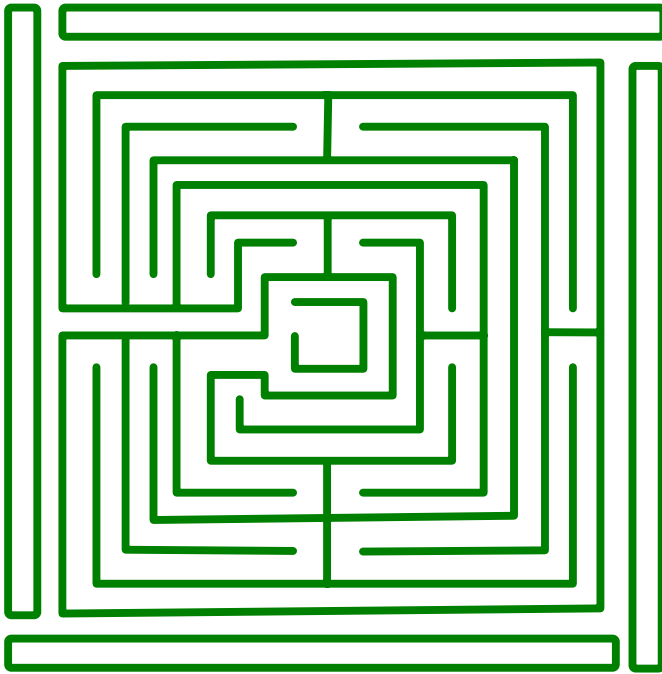
Figure 8: The plan of the labyrinth on Solovetsky Island (in the White Sea).



Figure 9: The plan of the labyrinth near the village of Rest, Arkhangelsk province.

4 *Labyrinths – Puzzles*

Labyrinths have had a strange fate! In ancient times, they were constructed with serious purposes, although not always clear to us. In deep antiquity, they guarded treasures hidden in tombs. In the dark times of the Middle Ages, they were used for executions. But centuries passed and labyrinths turned into objects of entertainment and play.



However, almost all present-day games were, at some point in the distant past, serious and necessary affairs. We now amuse ourselves with archery; for us, it is a game, entertainment. But for our ancestors – primitive hunters, or ancient warriors – it was a very important matter, a question of survival; those who could not shoot well with a bow could not procure food through hunting or defend themselves from enemy attacks. When the gun was invented, the bow became unnecessary and turned into a child's toy among civilised peoples. We now play hide and seek; for children, it is a fun game. But in ancient times, the skill of skillfully hiding from enemies was necessary even for adults. Almost everything that now serves to amuse children was in ancient times an important and necessary matter for adults.

Now the mazes are arranged for fun. There are not only garden



Figure 10: Puzzle to solve on paper.

Figure 11: Puzzle to solve on paper.

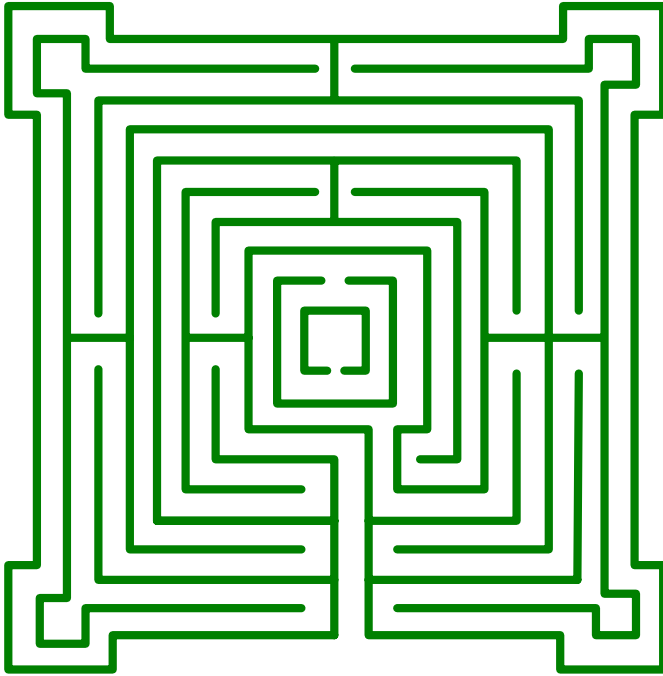


Figure 12: Puzzle to solve on paper.

labyrinths (Figure 10, 11, 12), but also labyrinth drawings drawn on paper; they are meant to be played. Figure 13 and 14 are examples of such maze puzzles. They are quite confusing, but it is not so easy to get out of their middle.

An interesting example of the unexpected application of a labyrinth can be seen in the illustration in Figure 15. It can be called an “agitation” labyrinth because it was conceived with an agitation purpose. One English magazine undertook a fund-raising campaign to establish a playground for proletarian children. To attract the attention of readers to this cause, the magazine printed a labyrinth, at the entrance of which a factory settlement with smoking chimneys is depicted, and in the centre – a well-equipped playground for children. Long, winding passages leading from the factory settlement to the playground vividly demonstrate how difficult it is for the children of workers to reach places with clean, healthy air (Figure 16).

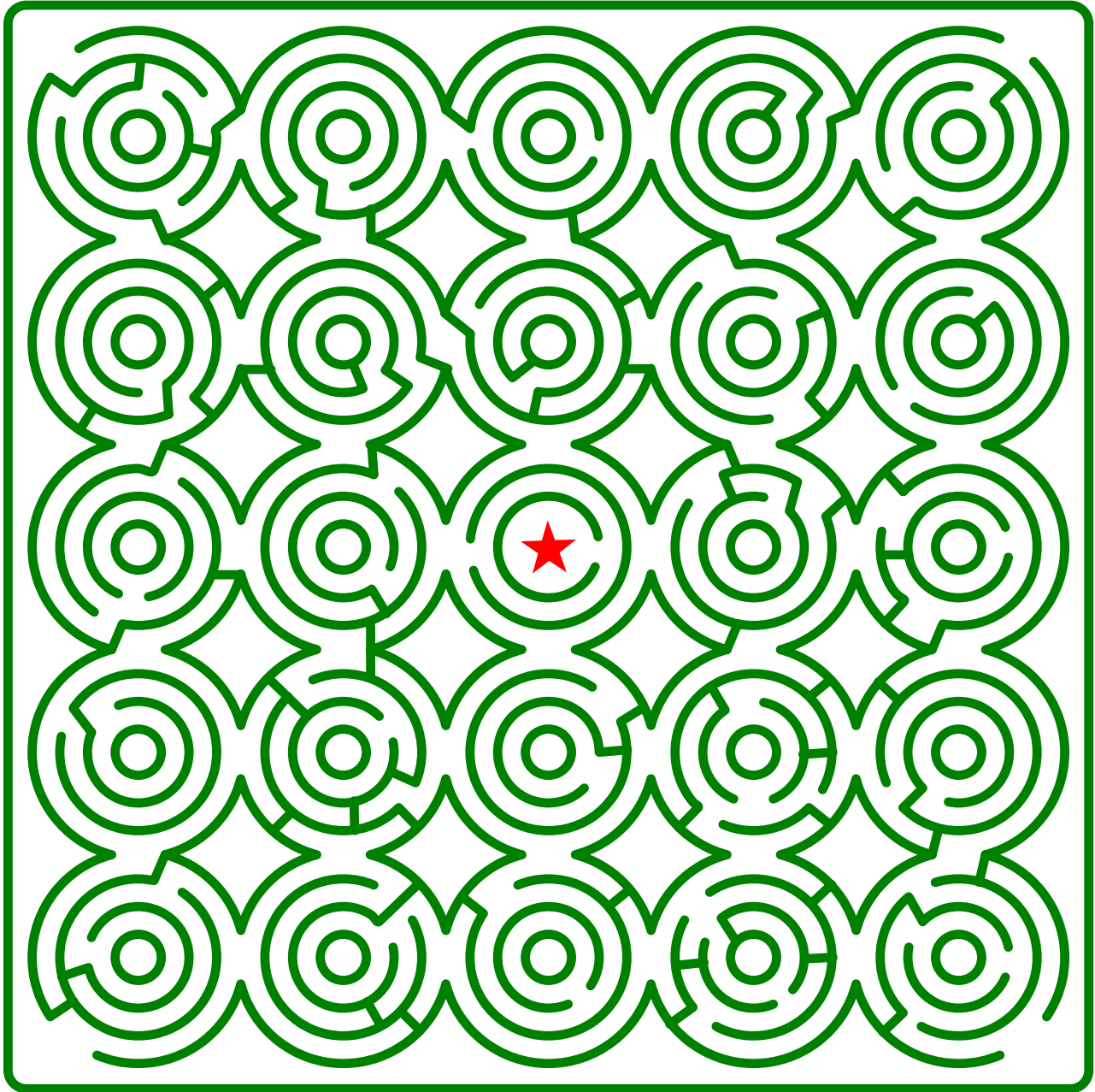


Figure 13: Puzzle to solve on paper.

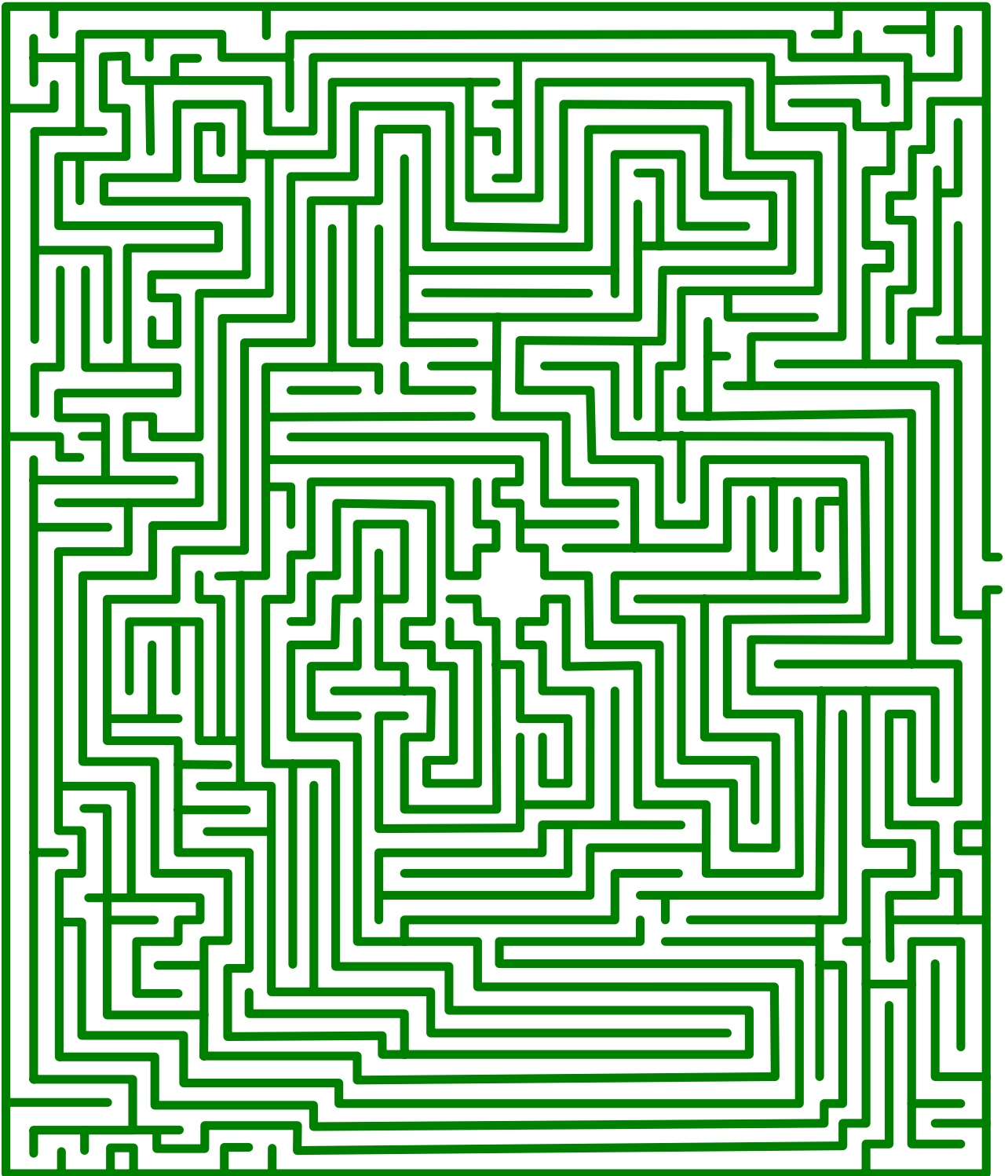


Figure 14: Puzzle to solve on paper.

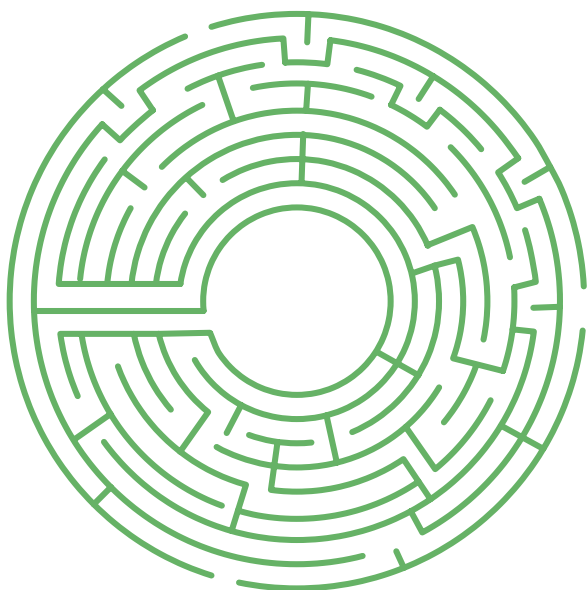


Figure 15: Agitation labyrinth.

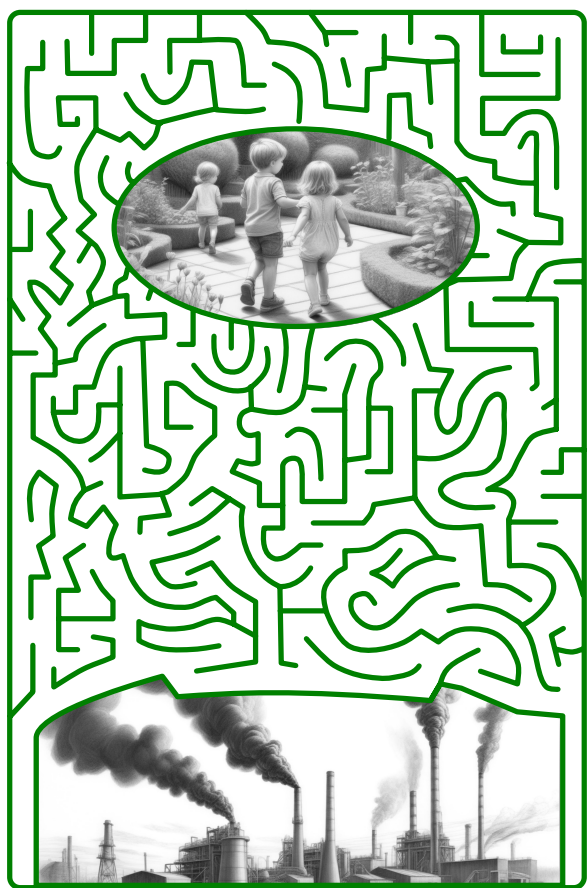


Figure 16: Help children find a path away from the pollution to the playground.

5 *Labyrinths-Caves*

Ancient writers believed that if the paths of a labyrinth are very tangled, then a person who enters it will never be able to get out: they will wander in vain through the passages, repeatedly returning to the same places and futilely seeking a way out. But this is not true. Mathematics can prove that there are no impassable labyrinths. We have already discussed the 'one-hand rule', according to which one can confidently enter a labyrinth and exit from it without fearing to get lost. However, this rule is not sufficient to visit all dead ends and corners of the labyrinth without missing any. For a complete exploration of the labyrinth, one must act differently.

People sometimes have to solve such problems in practise. There are many caves that scientists find very interesting to explore. Some of these underground caverns are quite extensive, with numerous branches and long tangled corridors. To dare to venture into the depths of such a natural labyrinth, one must take a number of precautions.

Two hundred years ago, the French botanist Tournefort decided to visit and explore a cave on the island of Crete. The locals believed that this cave, abundant with numerous underground passages, represented a true labyrinth: those who recklessly ventured into it were doomed to perish.

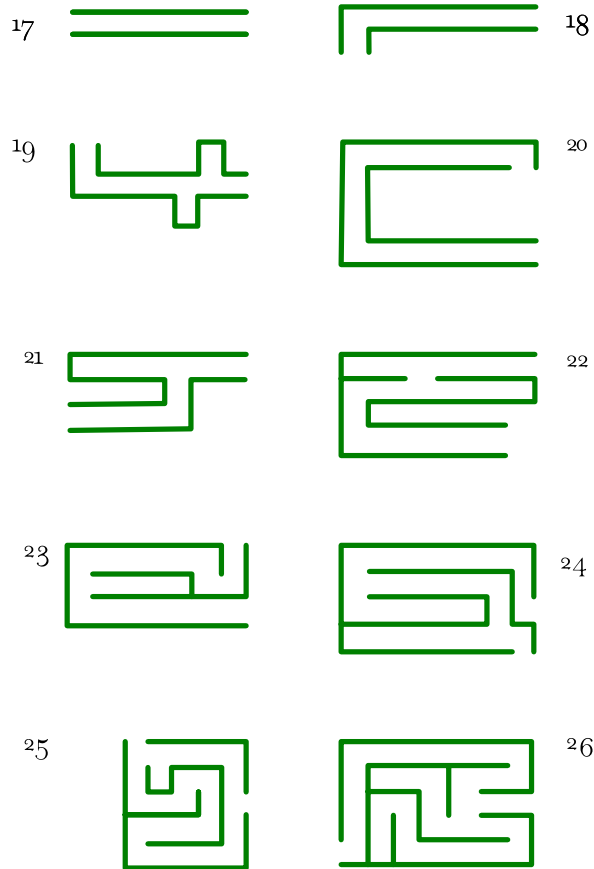
But the French scientist was not deterred by these grim tales. They only urged him to be very cautious. Here is what he tells about his journey into the depths of the cave:

'After wandering for some time with my companions through a whole network of underground corridors, we approached a long and wide gallery that led to a vast chamber in the depths of the labyrinth. We travelled,' says Tournefort, 'for half an hour, covering around one and a half thousand steps along this gallery, without turning right or left... On both sides of it stretch so many corridors that one would surely get lost in them if proper precautions were not taken; and since we were eager to find our way out of this labyrinth, we took care to ensure our return path.'

'First of all, we left one of our guides at the entrance to the cave and instructed him to immediately gather people from the neighbouring village for our rescue if we did not return by nightfall. Secondly, each of us carried a lit torch. Thirdly, at every turn that we thought might be difficult to find later, we attached numbered

papers to the right wall. And fourthly, one of our guides placed bundles of ferns he had prepared in advance on the left side, while another sprinkled the path with chopped straw, which he carried with him in a bag the whole time.'

Later, a French mathematician developed a system of rules, following which one could navigate through all the passages of even the most tangled labyrinth and safely exit. However, these rules are very complex, and we won't list them here.

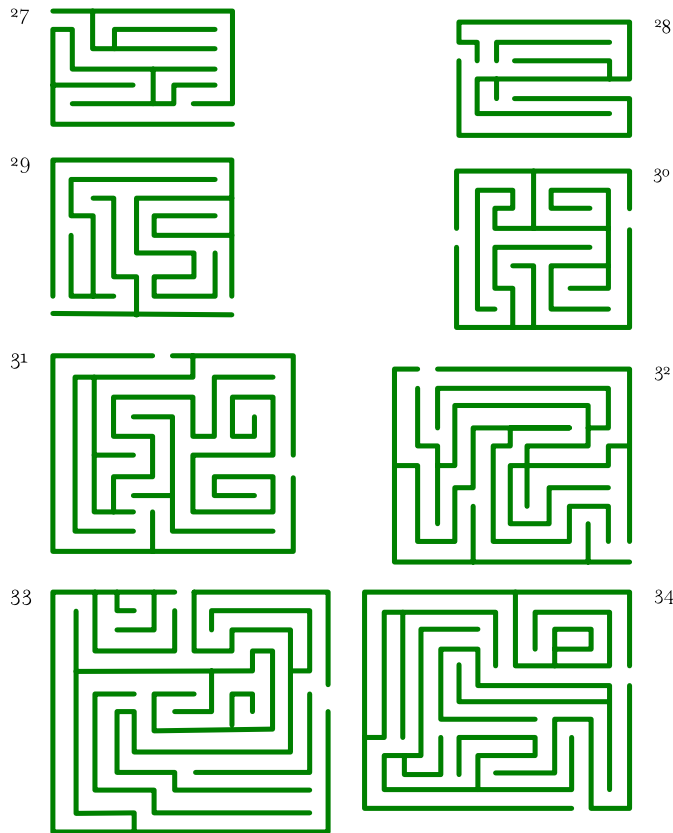


6 Labyrinths-Puzzles

The complex rules mentioned earlier are only necessary when one is truly wandering in a real labyrinth, especially a very tangled one. However, if the labyrinth is drawn on paper and not overly complex, then a simple cleverness, a natural knack, is enough to find the right path. Some manage to do this quickly, while others take longer. By how adeptly a person handles such a task, one can judge

their resourcefulness.

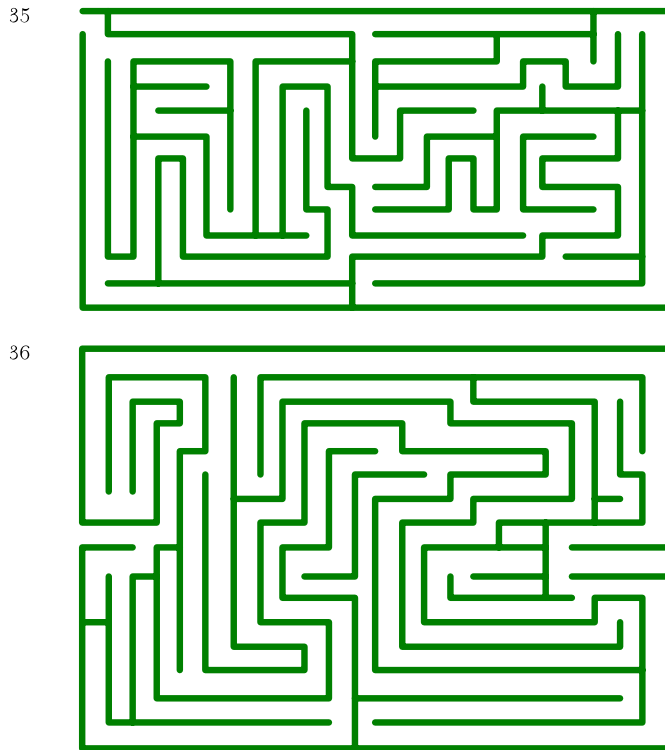
In recent times, a similar method has been used in England and to some extent in our country to test the ingenuity of schoolchildren. Let me tell you about a similar experiment conducted in Leningrad.



Figures ??-36 depicts the labyrinths used to test the resourcefulness of students. There are twenty labyrinths in total. The first ones pose no real difficulties and are only intended to engage the students. However, as you progress, the labyrinths become more challenging.

Here's how the test is conducted: The student is given a notebook containing these labyrinths and must indicate with a pencil line how to navigate through them from the entrance to the exit using the shortest path, bypassing all dead ends. Those who flawlessly complete all twenty labyrinths within four minutes have average, normal resourcefulness. Those who complete it faster are more resourceful, while those who still have uncompleted labyrinths after four minutes are less resourceful, and the worse they perform, the more uncompleted labyrinths they have left. Of course, time is

carefully monitored throughout the test.



In schools, these labyrinths are used to test multiple children at once every student in a whole class. Students are given notebooks with labyrinths but are instructed not to open them until given the command. Upon command: “Get ready!” The children take their pencils and get ready. Upon the command “Begin!” they open their notebooks and start working. The supervisor monitors the time closely. When four minutes have passed, they give a signal, and everyone must make a note in their notebook of which labyrinth they were working on when the signal was given. Then they continue the experiment for a few more minutes until all twenty labyrinths have been completed.

Of course, not everyone completes the task in the same amount of time. Some lag behind by just a minute, others by two, three, or even four minutes, meaning they complete all the labyrinths in eight minutes. If they haven’t finished within eight minutes, the experiment is not continued, as it has been observed that those who cannot complete it within this time frame are generally incapable of completing the task at all.

On average, primary school students were able to complete about

eighteen labyrinths in four minutes, while secondary school students completed around nineteen. Very young children/preschoolers were only able to complete thirteen labyrinths in four minutes.

Adults, in such tests, were able to complete all twenty labyrinths within four minutes, and sometimes even within three minutes.

7 Experiments With Animals

The most unexpected application of labyrinths was found by zoologists, who began using them to test the intelligence of animals. This experiment is conducted not on drawings but in actual labyrinths, albeit small ones. For this purpose, a scaled-down version of the same Hampton Court maze mentioned at the beginning of our book and referred to in Jerome's humorous story is often used. The labyrinth is set up in a box under glass. Through an outer passage in the labyrinth, a hungry mouse or rat is introduced into the box, and they must learn to find the shortest path to the center, where food is prepared. The experiment is repeated many times; the animal makes fewer unnecessary loops each time and eventually learns to reach the center, avoiding all dead ends. Rats, in particular, learn this very quickly; mice may have to repeat the experiment seventy times before they learn to find the shortest path, whereas rats learn much more quickly. This demonstrates that rats are much more clever and resourceful than mice. Experiments of this kind are still being conducted today (in laboratories in North America), and they will likely reveal much interesting information about the intelligence of animals.

Our conversation about labyrinths has come to an end. You can see how unusual their fate is. From mysterious structures of ancient times, whose purpose often remains a puzzle for us, they have gradually transformed into a means of amusement and entertainment. And most recently, they unexpectedly regain serious significance: scientists use them as a convenient method for studying the natural intelligence of humans and animals. The historical destinies of labyrinths are as intricate as their own passages.